

Sub
02
03
04
05
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
24
25

WHAT IS CLAIMED IS:

1. An optical coupling system comprising:

a first lens having an incident surface disposed in a certain direction and having a positive refractive power, by said first lens, Gaussian beam-like luminous flux incident on said incident surface from a light source being converted into approximately parallel luminous flux; and

a second lens having the same refractive power as that of said first lens but having an incident surface and exit surface disposed in a reverse direction, by said second lens, said approximately parallel luminous flux incident on said incident surface of said second lens being converted into converged luminous flux, said converged luminous flux being incident on a light-receiving unit;

wherein a distance $2L$ between the two lenses is selected to be in a range given by an expression:

$$1.8L_{max} \leq 2L \leq 2L_{max}$$

in which $2L_{max}$ is a maximum distance allowing beam waists to be formed at equal distances from the two lenses respectively.

2. An optical coupling system according to claim 1, wherein total coupling loss is equal to or smaller than coupling loss which occurs when the distance $2L$ between the two lenses is in a range given by an expression $0 \leq 2L < 1.8L_{max}$.

3. An optical coupling system comprising:

a lens having a positive refractive power, by said lens,

Gaussian beam-like luminous flux emitted from a light source being converted into approximately parallel luminous flux; and a reflection surface disposed at the rear of said lens so that said approximately parallel luminous flux is reflected by said reflection surface to return to said lens, said returning luminous flux being converted by said lens into converged luminous flux which is incident on a light-receiving unit disposed in said light source and its vicinity;

wherein a distance L between said lens and said reflection surface is selected to be in a range given by an expression:

$$0.9L_{\max} \leq L \leq L_{\max}$$

in which L_{\max} is a maximum distance allowing said lens to form a beam waist.

4. An optical coupling system according to claim 3, wherein total coupling loss is equal to or smaller than coupling loss which occurs when the distance L between said lens and said reflection surface is in a range given by an expression $0 \leq L < 0.9L_{\max}$.

5. An optical coupling system according to claim 2 or 4, wherein said total coupling loss is not larger than 0.05 dB.

6. An optical coupling system according to Claim 1 or 3, wherein said light source and said light-receiving unit are constituted by end surfaces of optical fibers which are equal in mode field diameter to each other.

7. An optical coupling system according to claim 3, wherein

Sub B1 end
an end surface of an optical fiber serves as said light source
and also as said light-receiving unit.

8. An optical coupling system according to claim 1 or
3, wherein said lens having a positive refractive power is a
5 rod lens having a gradient index distribution in a direction
of a radius thereof.

Sub A2
9. An optical coupling system according to claim 1 or
3, wherein said lens having a positive refractive power is a
10 plano-convex lens having a gradient index distribution in a
direction of an optical axis thereof.

10. An optical coupling system according to claim 1 or
3, wherein said lens having a positive refractive power is a
plano-convex lens made of a homogeneous material.

11. An optical coupling system according to claim 1 or
15 3, wherein said lens having a positive refractive power is a
sphere lens made of a homogeneous material.

12. An optical coupling system according to claim 1 or
3, wherein said lens having a positive refractive power has a
grating lens surface.

20 13. An optical device comprising an optical coupling system
defined in claim 1, and an optical functional device disposed
at a midpoint between the two lenses in said optical coupling
system.

Sub B3
25 14. An optical device according to claim 13, wherein said
optical coupling system is provided as an optical coupling system

array in which optical coupling systems having the same function are arranged in a row or in a plurality of rows.

15. An optical device comprising an optical coupling system defined in claim 2, and an optical functional device disposed at a midpoint between the lens and the reflection surface in said optical coupling system.

16. An optical device according to Claim 15, wherein said lens is provided as a lens array in which lenses having the same function are arranged in a row or in a plurality of rows.

17. An optical coupling system according to claim 1, wherein said first lens is physically the same as said second lens.